POLYMERS AND COPOLYMERS FOR GEL POLYMER ELECTROLYTES USABLE IN ELECTROCHEMICAL CURRENT SOURCES

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Abstract: This paper deals with description of preparation and use of polymers and copolymers for gel polymer electrolytes usable in electrochemical current sources. Theoretical part of this paper describes electrolytes focused on gel electrolytes. Experimental part deals with sample composition of gel electrolytes, preparation of samples and evaluation of measured samples. Linear Sweep Voltammetry (LSV) and Potentiostatic Electrochemical Impedance Spectroscopy (PEIS) were used for evaulation of samples.

Keywords: Gel polymer electrolytes, monomers

1 INTRODUCTION

Nowadays, when we can not imagine life without electronical devices, it is also very important to think about the sources of electricity used in them. In the case of electrochemical current sources, we are looking for an optimal quality /price ratio. The long-term goal is to develop resources that excelled in its reliability in various applications, availability, security and we expect ecologically friendly materials used in production.

2 GEL POLYMER ELCTROLYTES

In the field of electrochemical current sources, gel polymeric electrolytes have been discussed over the past few years. These electrolytes consist of polymer, inorganic salts and organic liquids.

The main advantages of gel polymers are: higher safety (do not use poisonous organic solvents), high shape flexibility (very thin batteries can be produced) and resistance to higher temperatures and pressures [1]

The polymeric mesh prevents leakage of the liquid from the matrix and gives the gel the properties of the solid. Organic liquid serves as a plasticizer and gives the matrix the properties of the liquid. The basic requirements for these electrolytes are: high ionic conductivity over a wide range of heat, good mechanical properties, thermal and electrochemical stability and high service life. The conductivity of these electrolytes is in units of mS / cm. [1]

The method of preparing the polymeric electrolytes is based on mixing the monomer with a salt solution, a polymerization initiator and a crosslinker in an aprotic solvent. Every part of the gel preparation takes place in a vacuum environment. It is necessary to initiate polymerization with thermal or ultraviolet radiation.

The basic composition of the gel is:

- Salt Lithium hexafluorophosphate ($LiPF_6$)
- Solvent diethyl carbonate and ethyl carbonate (EC / DEC)

- The initiator of polymeration benzoin ethyl ether (BEE)
- Crosslinking agent Ethylene glycol dimethacrylate (EDMA)
- Monomer EMA (ethyl methacrylate) and TSPMA (trimethoxysilylpropyl methakrylate)

3 MEASURING

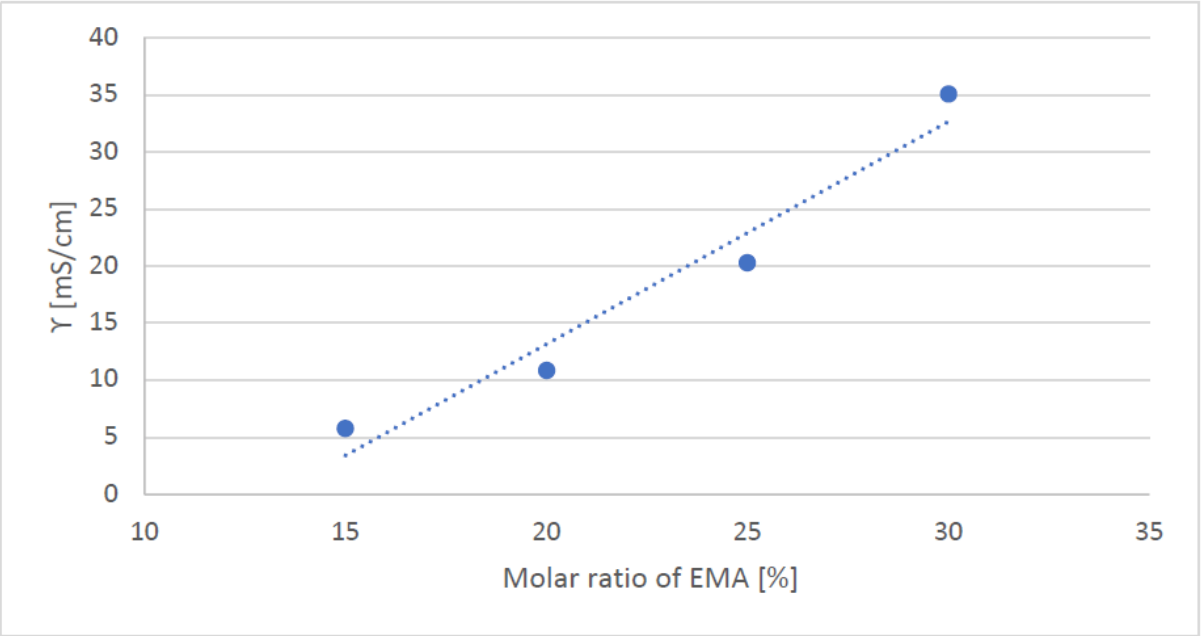

Figure 1: Graph od conductivity and molar ratio of monomer EMA

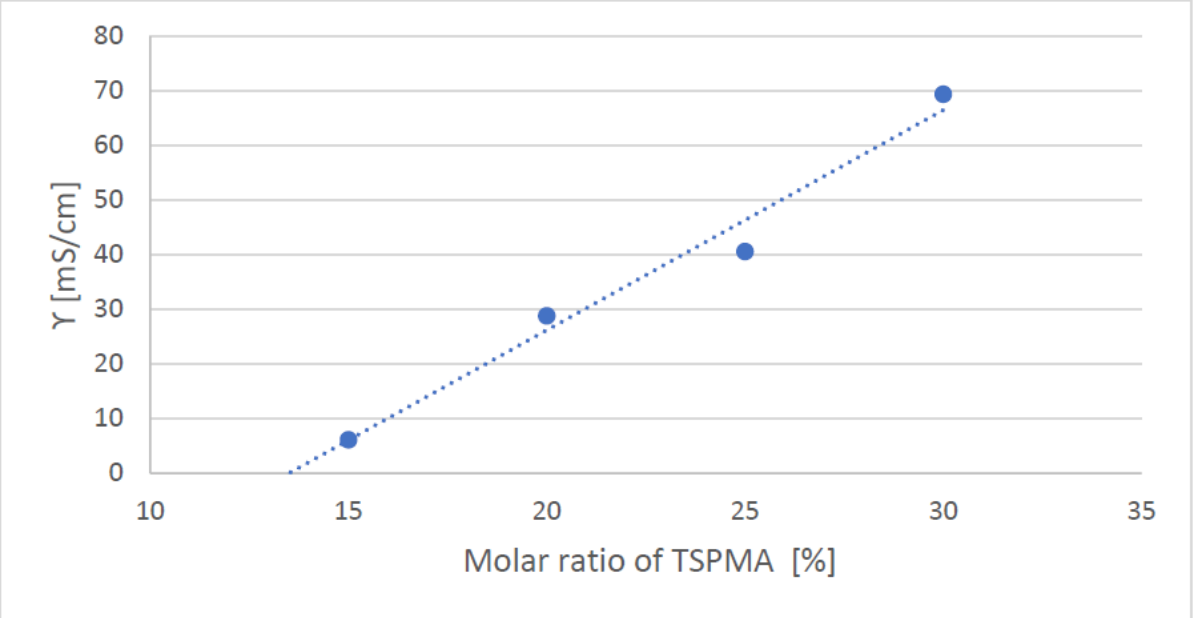

Figure 2: Graph od conductivity and molar ratio of monomer TSPMA

Figures 1 and 2 show the molar ratio of the monomer to the conductivity. In the graphs we can see that the conductivity increases with the molar ratio of the monomer. This dependency is almost li-

near. Only 15%, 20%, 25%, and 30% are used in the graph because the gels with 5 and 10 mol% didn't polymerized.

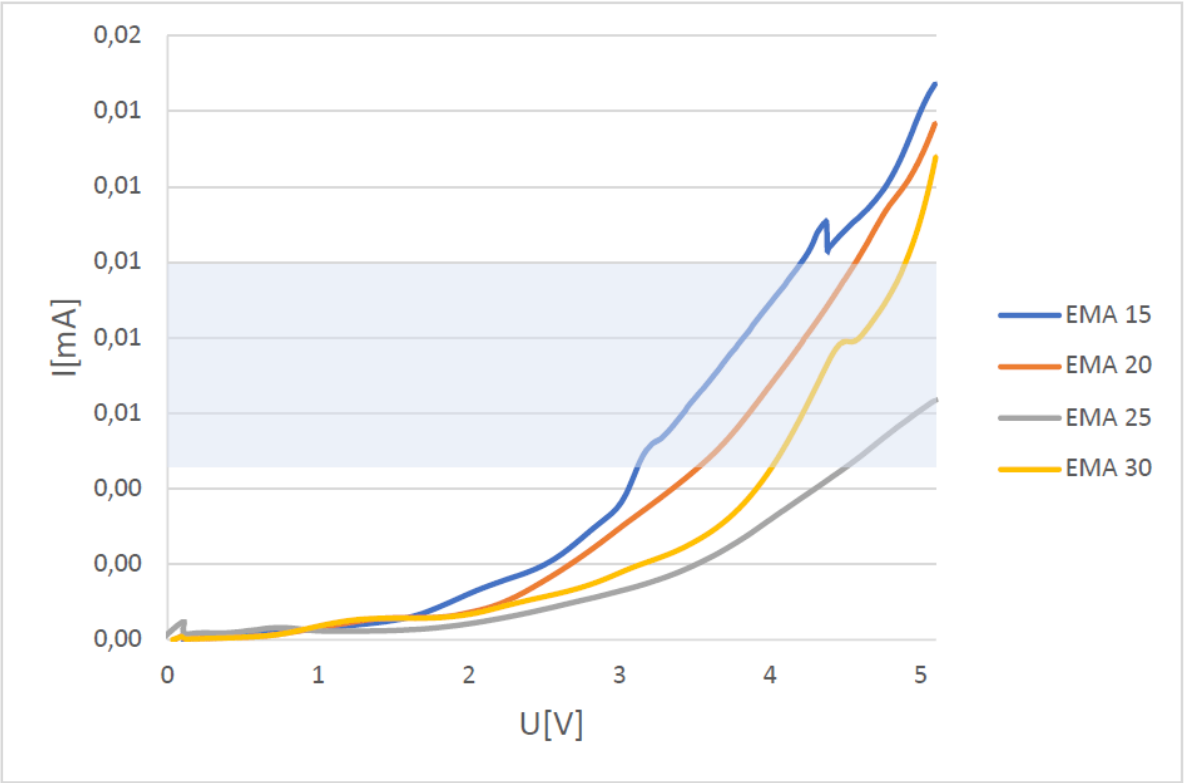

Figure 3: Potential window of GPE with monomer EMA

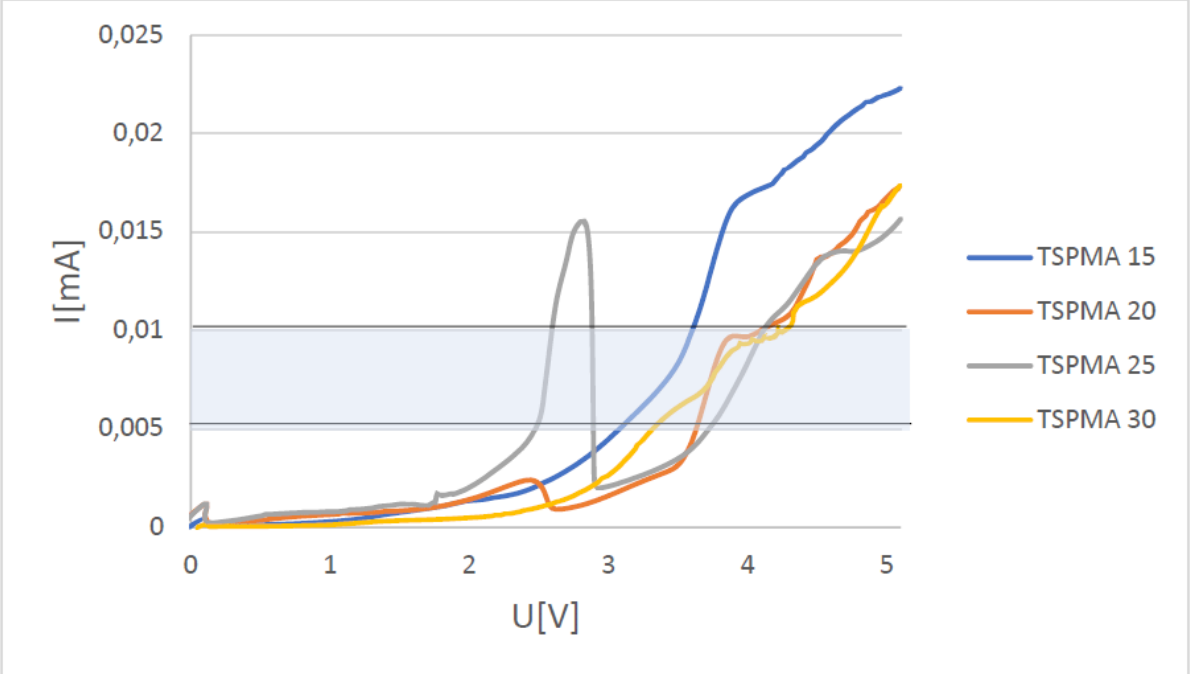

Figure 4: Potential window of GPE with monomer TSPMA

For samples with EMA monomer, the conductivity value ranged from 5.79 mS / cm (for 15 mol%) to 35.13 mS / cm (for 30 mol%). Voltage values ranged from 3.17V to 4.07 V for current 5μA and from 4.21V to 4.89V for 10μA current.

The samples with TSPMA monomer, a higher conductivity of 6.25 mS / cm (for 15 mol%) to 69.47 mS / cm (for 30 mol%) was measured. We see that for 30 mol% the conductivity is almost double that of the EMA sample with the same molar percentage. For this sample, the potential window is smaller. For a current of 5 μA the voltage was in the range of 3.07 to 3.31 V and for 10 μA of 3.60 to 4.27 volts.

4 CONCLUSION

The following research will be focused on the study of gel polymeric electrolytes based on copolymers. The copolymers will be mixed from two monomers with different molar proportions: the MMA monomer and one of the selected monomers. For all prepared samples, the electrochemical and mechanical properties will be measured.

REFERENCES

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